

CLAIMS

We claim:

1. A liquid separation asymmetric membrane comprising a tubular braid  
5 support synthetic resinous yarn woven so that said braid has a stable heat-pre-  
shrunk length which is in the range from about 1% to 20% less than its  
unshrunk length and an air permeability less than 10 cc/sec/cm<sup>2</sup> at 1.378 kPa.
2. The tubular braid support of claim 1 wherein said braid, stretched  
10 longitudinally, has an extension at break of at least 10%.
3. The tubular braid support of claim 1 wherein said braid is woven with  
from 16 to 60 carriers, each using multifilament 150 to 500 denier yarn, each  
multifilament being made with from 25 to 750 filaments, each filament being  
15 from 0.5 to 7 denier, said yarn comprising from 1 to 3 multifilament ends.
4. The tubular braid support of claim 3 wherein said braid has from 30 to 45  
picks (crosses/inch).
- 20 5. The tubular braid support of claim 4 wherein said filaments formed from  
a synthetic resin selected from the group consisting of polyester, polyamide,  
polyolefin, polyamine, polyurethane, polysulfone and cellulose acetate.
6. The tubular braid support of claim 5 wherein said braid has a wall thick-  
25 ness in the range from 0.2 mm to less than three times the thickness of said  
yarn.
7. The tubular braid support of claim 5 wherein said synthetic resin is  
selected from the group consisting of polyester and polyamide, said braid has  
30 sufficient strength to exhibit a load at break of least 50 lb-force.

8. The tubular braid support of claim 7 wherein said braid has an inside diameter more than 0.5 mm, an outside diameter less than 3 mm and a wall thickness in the range from about 0.2 mm to about 1.0 mm.

5 9. In a flexible macroporous tubular braid support for an outside-in hollow fiber asymmetric membrane having a tubular film of synthetic resinous material supported on the outer circumferential surface of said braid without the support being embedded in said film which has a wall thickness of less than 0.2 mm, the improvement comprising, from about 16 to 60 separate yarns, each on its own  
10 carrier, each yarn using multifilament 150 to 500 denier (gm/9000 meters) yarn, each multifilament being made with from 25 to 750 filaments, each filament being from 0.5 to 7 denier, said braid being woven with from 1 to 3 multifilament ends at from 30 to 45 picks (crosses/inch).

15 10. The tubular braid support of claim 9 wherein said ends are non-plyed in each said yarn but lie linearly adjacent each other until taken up to form said braid which is pre-shrunk to a length in the range from about 1% to 8% less than its unshrunk length.

20 11. The tubular braid support of claim 9 having a cylindricity greater than 0.8 and a maximum extension at break of at least 10%.

25 12. The tubular braid support of claim 11 having a wall thickness in the range from about 0.2 mm to less than three times the diameter of said yarn, and a maximum extension at break of at least 20%.

13. The tubular braid support of claim 11 wherein said separate yarns are woven in a pattern chosen from Regular, Diamond and Hercules.

30 14. In an outside-in hollow fiber asymmetric semipermeable membrane

comprising,

(i) a macroporous foraminous tubular support means having an outer surface;  
and,

5 (ii) a polymeric film of a reaction product of (a) a complex of polyvinylidene difluoride (PVDF) with calcined  $\alpha$ -alumina particles, and (b) a hydrophilic polymer adapted to impart hydrophilicity to said membrane;  
said particles having a primary particle size in the range from about 0.1  $\mu\text{m}$  to 5  $\mu\text{m}$  being present in an amount at least 1 percent by weight, but less than 50 percent by weight, of said film;

10 said film being supported by said outer surface, and said film having a peripheral barrier layer or "skin" integral with successive microporous layers having pores having an average diameter in the range from about 0.01  $\mu\text{m}$  to about 0.3  $\mu\text{m}$ , in open communication with each other,

the improvement comprising,

15 a flexible macroporous tubular braid support comprising from about 16 to 60 separate yarns, each on its own carrier, each yarn using multifilament 150 to 500 denier (gm/9000 meters) yarn, each multifilament being made with from 25 to 750 filaments, each filament being from 0.5 to 7 denier, said braid being woven with from 1 to 3 multifilament ends at from 30 to 45 picks (crosses/inch).

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15. The hollow fiber of claim 14 wherein said macroporous foraminous tubular support means support means has a stable heat-pre-shrunk length which is in the range from about 1% to 20% less than its unshrunk length and an air permeability less than 10 cc/sec/cm<sup>2</sup> at 1.378 kPa.

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16. The hollow fiber of claim 15 wherein said filaments are formed from a synthetic resin selected from the group consisting of polyester and polyamide.

17. The hollow fiber of claim 15 wherein said braid, stretched longitudinally,  
30 has an extension at break in the range from 10% to 30%.

18. The hollow fiber of claim 16 wherein said braid has an inside diameter more than 0.5 mm, an outside diameter less than 3 mm and a wall thickness in the range from about 0.2 mm to about 1.0 mm.

- 5 19. The tubular braid support of claim 18 wherein said separate yarns are woven in a pattern chosen from Regular, Diamond and Hercules.